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ART. II.* — *Climatology of the United States, and of the Temperate Latitudes of the North American Continent. Embracing a full Comparison of these with the Climatology of the Temperate Latitudes of Europe and Asia. And especially in regard to Agriculture, Sanitary Investigations, and Engineering. With Isothermal and Rain Charts for each Season, the Extreme Months, and the Year. Including a Summary of the Statistics of Meteorological Observations in the United States, condensed from recent Scientific and Official Publications.* By LORIN BLODGET, Author of several recent Reports on American Climatology, Member of the National Institute, and of various Learned Societies. Philadelphia: J. B. Lippincott & Co. 1857. 8vo. pp. 536.

CLIMATOLOGY is a recent science, and by some is held to have not yet attained the certainty of a science. While climate and its varieties are as old as the world, and while temperature is its grand element, and has long been known to be such, its modifying powers and the laws of their action were too obscure to be ascertained by any means and instruments in use till within the century past. What appliances had the Greeks or Romans, the Persians or Assyrians, or even the Egyptians, much less the nations of Europe, in the Middle Age of our era, to ascertain the force and laws of these modifying influences? Connected, indeed, as climatic phenomena are, with the universal interests of men, philosophic minds, like those of Aristotle and Theophrastus, Aratus and Virgil, before the Christian era, and Pliny and others soon after its commencement, could not but think and write concerning them. But their speculations on the subject had no value. The instruments for investigation were wanting. These are chiefly four, — the Thermometer, the Barometer, the Rain-gauge, and the Hygrometer, — all of which were invented since about the middle of the seventeenth century, and have been greatly improved in later years. The mercurial thermometer of Fahrenheit was not graduated by him till 1721, and the report of its graduation was first published in the Philosophical Transactions of 1724. Nearly a century passed from the invention of the thermometer, before any valuable observations were made by means of it. Indeed, we must pass to the latter part of the eighteenth century for these, and, for the most extensive and valuable, to the first half of the nineteenth. But the thermometer has proved to be to climatology what the sun is to climate itself, — the all-important element. It has yielded to investigators the very facts which lie at the foundation of the science.

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* Shortly after the publication of Blodget's Climatology, a contributor, deservedly eminent for his attainments and services in natural science, prepared a thorough review of it. The greater part of this review was lost by an accident on the New York Central Railroad, in which sundry mail-bags were thrown into water, and their contents damaged beyond restoration. A few of the last sheets, sent by a subsequent mail, alone reached us; and as they admitted of being printed as an independent article on several of the topics discussed in the book, we published them in our number for October, 1858. Since that time our friend has rewritten from memory the lost portion of his article, which we here present to our readers.

Chemistry, a recent science, was also needed to ascertain the laws of caloric, as free, or specific, or combined, before this instrument could be adequate to its work. This, too, has been effected only in the century preceding the present day. The fluctuations in temperature and the variations in climate thus began to appear as governed by regular laws. It was seen, also, that definite conclusions on climate could be attained from the average of long and extended series of regular observations in all the countries where science and civilization cooperated. A series of observations by means of the thermometer, or by any, or all, of the above-named instruments, from which no average is deduced, is, like the weather or climate itself, simply a series of facts in consecutive order. It took a century for observers to learn the indispensable necessity of regular observations, at the same hours, and with similar accurate attention, through all the seasons of the year. Then the averages could be obtained for comparison, and the great facts learned of the general uniformity of climate in any given locality. Hence Blodget writes: "The measures of heat, moisture, rain, and atmospheric weight, are all to be treated alike in this respect; the averages afford fixed quantities, which must first be defined, and from these the distance to which extremes go." (p. 17.)

We will now look at the testimony of history on the state of climatology only forty years ago. Howard, in his "Climatology of London," published in 1818, shows the science to be in its purely infantile state, and announces, that, with all the accumulation of observations at that time, he "may probably venture to anticipate some of the conclusions which must ultimately be derived." He gave a classification of the clouds, under seven different names for that number of distinct forms or modifications, which, though considered "fanciful" by his contemporaries, constitute with slight changes the present nomenclature of those splendid, changing, and wonderful aggregations of visible vapor, or of very "minute drops of water" floating in the atmosphere. The forms were considered as presenting very certain indications of weather at hand. The "Cirrus" clouds, when alone, rarely, if ever, yield rain; the "Cumulus" never appear but in fair weather; the "Stratus," or fog rising from the earth over the valleys and streams, indicates a pleasant day; the "Nimbus," composed of dense rolled-up masses or thunder-heads below, over-topped by the expanded cirrus, surely forebodes the shower in which lightnings often play the principal part; the "Cirro-cumulus," in moderate collections, or spread out in small masses and at different elevations, must be changed or disappear in invisible vapor before the fair weather passes away. The two others, generally appearing in storms, — the "Cirro-stratus" especially being the usual precursor of continued rain or storm, — may sometimes cover the sky, attended with more or less wind, but not with either rain or snow. Another instrument, the barometer, is wanted to make the indications probable.

In an article on Meteorology, written near forty years ago, in England, it is stated that no fixed hours of observing the temperature had been adopted; that no hours had been ascertained whose mean would give the approximate mean of the day; that there was no system of careful observation at any hours; that most of the meteorological observations had little practical importance; and that the maximum and minimum of the thermometer were employed by some in the belief that the mean of the extremes must approximate closely to the mean temperature of the day, especially as it coincided nearly with the mean of the observations at 10 A. M. and 10 P. M. The same writer maintained the necessity of daily observations at every hour in the day, through the year, of the sum of which hourly results the twenty-fourth part would be a near approximation to the mean temperature of each day, while from similar calculations the average temperature of each month and of the year would be attained. Yet he declares "this method, for obvious reasons, impracticable"; in other words, no one would then undertake the great labor of twenty-four daily observations for many consecutive weeks.

Yet in 1816 and 1817 this work had been begun in our country, and, from a sense of the necessity of twenty-four observations daily, had been successfully performed for many days in the different seasons of the year. The observations and the results were published, and the third part of the sum of the temperatures taken at the convenient hours of 7 A. M. and 2 and 9 P. M. was shown to be a near approximation to the mean of the twenty-four hourly observations.*

In 1817 Baron Humboldt published his essay on the Distribution of Heat, illustrated by a map of Isothermal Lines, exhibiting the isothermal positions of numerous places in Europe, and then extended across the Atlantic into North America. This essay was made known to the West of Europe by the translation of it in Brewster's Edinburgh Philosophical Journal in 1819-20, accompanied by important remarks.

In 1820 the government of the United States had just commenced, under the auspices of Mr. Calhoun, then Secretary of War, its noble system of meteorological observations at all the military posts in the country. The execution of the work was committed to the Medical Department of the army, under the direction of the Surgeon-General. Great praise is due to this department for the successful co-operation of the surgeons at the several posts. The hours of observation were fixed at

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* In 1825 or 1826, similar hourly observations were made at Leith, Scotland, through the year; in 1839, at Amherst College, by Prof. Snell; in 1843-5, for three years, at Toronto, C. W., published by her Majesty's government in 1853 and 1857, under direction of Col. Sabine; and in 1840-45, the Girard Observations at Philadelphia, under the direction of A. D. Bache, LL.D., published in 1847.

7 A. M. and 2 and 9 P. M. The results of these observations, to the end of 1842, were successively published.

In 1842, Dr. Forry was able to present to the public a more full view of the climate of our country than was ever before taken.* In 1844, he published very important additions to his previous volume, in two extended papers in the American Journal of Science, Vol. XLVII., with a plate of three isothermal lines across one half of the country, for summer heat of 65°, winter temperature of 41°, and mean annual heat of 52°. In this paper Dr. Forry refers, with high commendation, to the argument of Noah Webster, in 1806, against the views of the Abbé Du Bos, Buffon, Hume, Volney, and Gibbon, in Europe, and of Jefferson, Williamson, Williams, and Holyoke, in our country, as to the melioration of climate in the Old World and in the New. Dr. Forry's writings attracted only a very partial attention, so little interest had as yet been excited on climatology. The observed facts had been too limited, and their application could not then be ascertained.

Humboldt clearly foresaw the advantages of climatic representation by isothermal curves, and in his address before the Imperial Academy at St. Petersburgh, in 1828, he speaks of our governmental plan of observations in the following terms: "The government of the United States of North America, deeply interested in the progress of population and the varied culture of useful plants, has felt for a long time the advantages presented by the extent of its territory." He commended the example of the United States to the Russian government for imitation on a "great scale." Nobly did Russia respond to this call in succeeding years.

Johnston's "Physical Atlas," an admirable work of its kind, was published in 1849. It contained one Isothermal Chart, being "Humboldt's System of Isothermal Lines on the Globe," improved by Berghaus, excellent in its time, but too general, from want of an adequate number and variety of observations. It contained, also, a Chart of the Rain.

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* The Climate of the United States and its Endemic Influences, based chiefly on the Records of the Medical Department and Adjutant-General's Office, United States Army. By Samuel Forry, M. D. New York. 1842. pp. 378.

Still the progress of the science was slow in Europe, till Professor Dove, of Prussia, a few years ago, commenced his investigations, which have resulted in a more extensive exhibition and application of climatic data than had ever before been published.

In the United States, the advance has been great, on account of the extended range of military posts from Florida to the British Possessions, and from ocean to ocean. In 1855 the "Army Meteorological Register" for the twelve preceding years, with its consolidated tables of temperature for thirty-five years, gave to the world a fund of knowledge on various interesting points in the climatology of our country. There was, in the mean time, a great amount of observations in most of the older States, at the colleges and by private individuals; a regular plan was carried out by the State of New York of observations at her numerous academies, and also partially in Pennsylvania; and in the newer States amateur meteorologists had engaged in successful efforts in the same direction, so that there was a great accession of facts to those put on record at the military posts. To these are to be added similar records from British America, as well as from the Russian Possessions in the Northwest. In 1856 there existed means of extending, with increased accuracy, the isothermal lines across our continent, so as to connect them with those which Dove had already stretched on the Northern hemisphere over Europe and Asia.

At this point of time, and with these palpable advantages, Blodget's Climatology of the United States was begun and published. He had accumulated his data from both sides of the Atlantic, and especially from all parts of the United States, so that he could compare the climatic character of the temperate latitudes of North America, of Europe, and of Asia, and, in truth, of the larger portion of the Northern hemisphere. He had been engaged in climatological pursuits at the Smithsonian Institution, and had assisted in the preparation of the "Army Meteorological Register" of 1855, a quarto of 750 pages, from the Surgeon-General's Office of the United States, the Reports and Charts of which Mr. Blodget had planned and executed. The object of the present work is important, the range is extensive, and its announcement was as unexpected as its completion was desirable. In our country no similar publication had appeared; the field had been explored but very partially; the writings of Dove were unknown on this side of the Atlantic except by a few persons. The title of the work is suggestive of high pretensions. Let us, then, consider what has been accomplished by the author.

In the first place there is given a great amount of meteorological knowledge on the temperature and fall of rain, as fundamental facts in climatology. These are found in various extensive tables for easy reference and examination. One contains the "Mean Temperature for each Month, Season, and Year," at three hundred places in the United States and British America, with the latitude and longitude of the localities, their elevation above the ocean, and the date of observation. Among these we find, of course, the results obtained at the military posts of the United States. The value of this table is inestimable. After a table of less important localities, there is given a table of mean temperatures at numerous places in Northwestern and Tropical North America, and in the temperate latitudes of Europe and Asia, equally full and important. Next follows a table of rain and melted snow at two hundred and fourteen places in the United States, for each month, season, and year, with their date. To complete the statistics, we have, in fifteen pages, a closely-printed summary of the mean temperature at many localities in the United States, for each month and year severally, so as to present the monthly and annual mean variations at the same place for several years, and a similar table of the monthly fall of water for years at different places.

Such a mass of meteorological statistics for the Northern hemisphere has not been issued before from the American press. They present to every one the climatic facts on which important conclusions are to be formed and verified, and are the elements which make possible the construction of isothermal lines, and of rain or hyetal charts.

The results derived from the explorations directed by the government of the United States, from that of Captain Lewis and Lieutenant Clarke, in 1803; of Lieutenant Pike, in 1805-6;

of Major Long, in 1819–20 and 1823; of Nicollet, in 1836–40; of Colonel Fremont, first in 1842, secondly in 1843–4, and thirdly in 1845–6; of Major Emory, in 1846; of Captain Stansbury, in 1849–50; and from the magnificent system of surveys for a Pacific Railroad in 1853–5,—have been introduced by the author, and are the basis of that part of the work which treats of the climate of the vast country west of the Mississippi, without which that part of the climatology would have been impossible. One can hardly forbear to dwell with pride on the liberality of the government of the United States in the noble contributions thus made to geography, physical and descriptive, to botany, zoölogy, and geology, as well as to climatology. The munificence of the government to natural science, while prosecuting the material interests of the country, merits the admiration of the friends of learning and humanity. Our people and the world now appreciate the value and wisdom of the declaration of Humboldt in 1828, that a vast country "may advance more than any other the study of the atmosphere, the knowledge of mean annual temperatures, and, what is more important to vegetation, that of the distribution of the annual heat over the seasons."

These explorations have made most important developments in our climatology. Several important facts, formerly not imagined, and hardly believed when first stated, have been fully ascertained. Among these are the much loftier elevation of the great "Western interior, than was before assigned to it"; the existence of "high and arid plateaus and basins" in this lofty region, "in nearly as great a proportion" as are found in Europe and Asia; and the high temperature of the elevated valleys or plateaus of the West. These particulars have been held by writers on physical geography to produce a strong contrast between the climates of the temperate latitudes of our country and of the same parallels on the Eastern Continent. The facts show the "physical features of surface and configuration" to be nearly the same in both, and in their climates may be found many points of resemblance. The difference too may depend greatly upon the high altitude of the interior of this Western world. How much influence this fact must have is not readily ascertainable, and more extensive observations and measures may be required.

According to the estimate of Humboldt, the masses of mountains diffused equally over a continent would raise the general level inconsiderably. He states that the "mass of the Eastern and Western Alps would only increase the height of Europe about 21½ feet above its present level." In his Cosmos he gives the mean level of the land of North America at 748 feet, of South America at 1,152 feet, of Europe at 671 feet, and of Asia at 1,132 feet above the sea. More recent observations, however, must place the general level of North America higher than this estimate, and at least approaching that of Asia. Indeed, they may perhaps raise the level to 2,500 feet over the western half of the United States. It should be recollected, that of these lofty valleys or plateaus, that nearest the principal ridge of the mountains has at its highest part an altitude of 7,000 feet, while the mountains themselves rise several thousand feet higher. For, "so far from the Rocky Mountains forming but a single chain of elevations, or of mountains alone, they are rather the crests and representatives of lofty plateaus." The city of Mexico is situated in a valley, now computed to be 7,469 feet above the sea, an elevation not greater than a portion of the great valley at the eastern base of the highest ridge of the mountains farther north. The great North American basin, between the central ridge of the Rocky Mountains and the ranges which separate it from the Pacific Ocean, is very extensive, and, like the seas in the interior of Asia, it has no "external drainage." (p. 123.)

The Vertical Topography, with its table of altitudes, is another interesting article connected with climatology. Mr. Blodget divides the United States into two portions, separated by the Mississippi. The altitudes, beginning with the northeastern part of the United States, are given in twelve transverse sections across the country, in lines nearly at right angles to the general trend of the Alleghany range.

A similar course is pursued on the mountains west of the Mississippi, as they stretch along the meridians of 100° to 120°, so that the sections run nearly north and south. In the table are seen the altitudes of plains and plateaus, summits and passes between the summits, forts, rivers, and lakes.

The range of mountains is wide, the valleys between them extensive, and higher of course toward the base of the central ridge and the greatest elevations of this ridge. The whole configuration is fitted for producing strong climatic differences. The existence of "arid plains" of great extent is no longer a mystery. Thus, according to Fremont, Green River, in Utah, near lat. 42° and long. 110°, has an altitude of 6,230 feet; the summit of Central Plateau, near lat. 42½° and long. 109½°, has 7,490 feet elevation; Wind River Mountains, Oregon, lat. 43° and long. 110°, have an average height of 10,000 feet; and Fremont's Peak, the highest point of Wind River Mountains, is 13,570 feet above the sea. From this latitude, or near 43°, the mountains and valleys have a general slope northward, and the country becomes, north of the United States, less mountainous.

Elevation above the sea was mentioned among the modifying powers of climate. To this more special attention will be given in another connection. But it is doubtless to be ranked as one reason for the low temperature of our country as compared with portions of Europe and Asia in the same parallels. To this is to be added the different configuration of the two continents, especially as to the coast lines and the bays and coast indentations. In Europe we see the North Sea extending southward into the continent, the Baltic and its adjuncts on the west, with the Bay of Biscay, and on the south the Mediterranean and Black Seas into the hot countries south of them. Hence it is that Humboldt and Guyot have attached great importance to this among the "physical features of Europe," and especially to the seas and countries on the south.

As the higher temperature of the Northern hemisphere, compared with the Southern, is attributed to the much greater proportion of land in the Northern, we have another reason for the higher temperature of Europe and Asia north of the tropics, in the far larger extent of land in Europe and Asia than in North America. Consider, too, the great difference in the breadth of the land at or near the tropics in the two continents, our country being relatively narrow at the south. At lat. 30°, North America has a breadth of only 35° of longitude, and the Eastern continent a breadth of 90° ; while at 40°, North America extends across 50° of longitude, and Europe and Asia across 150°. There cannot be a doubt that this cause must have great influence in raising the temperature of the southern and middle portions of the Eastern continent. Then, too, the northern coast of the one is upon the open ocean, while that of the other abuts on interminable fields of ice.

The temperature of the southern and middle portions of the United States, however, is elevated somewhat by the influence of the Gulf of Mexico, which, stretching nearly across the southern border, acts, to a certain extent, as a reservoir of the hotter water of the Atlantic, brought into it by the trade-winds and the current from the South Atlantic, — the warm trade-winds themselves being arrested on the mountains of Mexico, and changed in their direction so as to set northward over the vast valley of the Mississippi and along the valleys between the Rocky Mountain ranges. Hence it is that the isothermal of 70° mean annual temperature varies the least from its general course over the Eastern continent as it passes along the southern part of the United States; the isothermal of 60° much more; and those of lower temperature still more.

The whole discussion of this topic is full of interest, and opens widely expansive views to the philosophic mind. Some conclusions may indeed require to be modified by future discoveries. For the whole ground has not yet been explored; the laws of known forces have not been fully ascertained; nor has the full influence of modifying causes been detected or adequately estimated. Nothing can be more strictly true, at this day, than the remark of the author, that "the relation of physical geography to climatology is confused and unsatisfactory." "A greater number of points of observation is required in the recently known districts of North America and Asia, not only of what the climate is, but of what the actual physical features are." The currents of wind and water, upon which the labors of Lieutenant Maury have already produced such increase of our knowledge and directed to the most beneficial commercial results; the phenomena of storms, upon which the lamented Redfield and the acute Espy have expended so much power; and the influence of mountains upon the climate of a country,—all need to be more extensively studied; and a vast number of additional observations must be made before this great subject will be exhausted, and the laws of climate be fully understood.

Our author may have made statements in advance of previous conclusions, and liable to be attacked or opposed even when true; or he may have over-estimated some of the modifying forces; but previous and opposing opinions, different from those he maintains, may themselves be uncertain from the want of sufficient data, or need to be corrected for some reason. Only the future will enable climatologists to ascertain the actual state of things in various respects. In the mean time let us say God-speed to all honest laborious efforts, and bestow at least the honor that is due to every true friend of science.

At page 210 is given the Isothermal Chart for the Northern hemisphere above lat. 20° north, affording data for a general comparison of the temperate climates of the eastern part of the United States with the west of Europe, and permitting the eye to rest on the great isothermals across the whole hemisphere. The relative temperature, and so far the climate, is splendidly exhibited, and appears as the panoramic vision of localized heat over this large portion of the earth.

To take only the lines passing through places whose mean annual temperature is 70° and 60° Fahrenheit, similar and singular results appear. The line of 60° Fahrenheit passes through the southern part of Japan, at lat. 34° north; thence strikes China in lat. 33°, inclining slightly to the south; thence runs on the parallel of 33°, nearly to the mountains east of the Mediterranean; thence in a northerly curve round the north border of that sea, a little north of Rome, in lat. 43°, and near the southern boundary of France; thence through Spain, a little south of Madrid, in lat. 39°, and a little north of Lisbon, to the Atlantic; thence inclining north of lat. 40° to the middle Atlantic; thence, verging southward, it strikes the United States in lat. 36°, near the middle of North Carolina, and runs through the northern part of South Carolina to the Mississippi in lat. 34°, and nearly four degrees north of New Orleans; thence southward to lat. 30° and long. 100° in

Texas, west of Austin; thence rapidly north and west near El Paso, in lat. 30°, on to lat. 39½°, northeast of San Francisco, and thence nearly south to the Pacific in lat. 35°. As this chart contains also the isothermals for the mean of summer and winter, it exhibits the differences of climate across the Northern hemisphere, the resemblance of much of the climate of the United States to that of Eastern Asia, and the tortuous changes made necessary by the configuration, mountains, and internal seas of salt or fresh water.

Much as Dove had extended his isothermals in his various publications, the means have not been before attained to present such an admirable chart for our country. It affects every eye with the impression that a new and brilliant light has suddenly shot above the horizon of climatology. Baron Humboldt has lived to see his anticipations of 1828 become almost a reality. "When the varied inflections of the isothermal lines shall be traced from accurate observations, continued for at least five years, in European Russia and Siberia, when they shall be prolonged to the western coasts of North America, the science of the distribution of heat on the surface of the globe, and in accessible strata, will rest on solid foundations."

It may be remarked, that the lines or curves of mean temperature of summer are by some writers called *Isotherals*, and of winter *Isochimals*, while those of the mean or average temperature are called *Isothermals*. By more frequent usage, now, all are called Isothermals for the mean of summer, winter, and the year.

At page 220 is the Hyetal or Rain Chart for both continents, showing conspicuously to the eye the quantity of deposition, or water from rain and snow which falls upon the various sections. The anomalies are very prominent, and the display most satisfactory. This is the more gratifying, as so much valuable light on the causes affecting the fall of rain in different sections has already been given to the world. But the chart and its explanations need no commendation to any seeing eye.

At the bottom of the two charts which we have last described is a profile view of the elevation of the mountain ridges in the Northern hemisphere, as they lie along the western coast of America and Europe. As connected with climate, this profile of altitudes will have much interest for the reader, from their influence, heat and rain being essential to vitality in the operations of nature (pp. 113–115).

In a more particular illustration of the climate of the United States, Mr. Blodget has given five Isothermal Charts, one for the mean temperature of each of the seasons, and one for that of the year, and five Hyetal Charts for the mean rain of the same periods. For our country these charts were a great desideratum. They present extraordinary variations in the mean temperature on the same and on different latitudes. The outlines are drawn on a much larger scale than that for both continents, and the flexures, of course, stand out in more boldness and fulness. It was to be expected that the isothermals would be turned northward, after crossing the Rocky Mountains, in the valley between this great range and the coast range of mountains, and, after crossing the latter, would turn southward again into the Pacific. But where the flexures fall and the changes occur, could be told only from the actual observations which the author has collected. These charts are not copies of those prepared by Mr. Blodget for, and published in, the Army Meteorological Register, but are founded on more extensive data, and differ in some important points by reason of the corrections he was able to make. The Register also had a limited circulation. Certainly the Climatology ought to be a common book in the libraries of our citizens. It is not improbable that more extended observations at more numerous localities, especially in the western two-thirds of the United States and the British and Russian Provinces, will lead to further corrections of both these sets of charts; though the great general outlines will probably not be obliterated by them.

As to isothermal charts, it should be remarked, that there are two principles of construction, each of which is claimed to have some advantages. The first method is, to use the mean temperature of various places as the sole directrix of the lines or curves. The isothermals then show the actual mean temperatures derived from observation at the places through which the lines pass, or they form the profile line of mean temperature of all the places along them. On this principle our author has proceeded in the construction of these charts. On this principle Humboldt is supposed to have formed the first isothermals ever drawn.

The second method is to make reductions of the observed mean temperatures to some more general standard; for example, to make the level of the ocean the standard of mean temperature for places of the same latitude, and to make certain definite corrections of the observed mean temperature of a place above the sea-level, or for difference of latitude, or *both*, so as to give the mean temperature of the place if it were situated on the level of the ocean on the thermal degree of latitude. The isothermal then becomes the profile of reduced mean temperatures, supposing the places on the sea-level; or it is the line of *theoretical*, and not of *actual* mean temperature; a line of *imaginary*, not of *real* average heat. In other words, such an isothermal represents a mean temperature which does not and cannot exist on that latitude, except at a place situated on the sea-shore and at the sea-level. For certain purposes, this method may have advantages; but the isothermals cannot then represent the unity of observation and fact.

That elevation above the ocean has an important influence on the temperature, and hence on the climate, has long been known. It could not but be noticed by the common eye, in the difference between the vegetation on high hills and that in the low plains. The contrast between the perpetual snow of the Alps, and other lofty mountains, and the heated valleys at their base, has ever been palpable. It remained for the moderns to discover, if possible, the law of this action; and this became a relatively easy work for the thermometer, with measurements from balloon ascensions, and other estimates of altitudes. That the true estimates must differ for different latitudes and for different seasons of the year, has always been conceded. Humboldt found from his observations on the Cordilleras, to an elevation of 5,000 feet, that the rate of decrease was variable at the different altitudes, but that the mean of the whole gave a fall in the thermometer of 1° for 341 feet. The variation was held to depend upon particular circumstances of the localities, while the mean was considered to be a reasonable approximation. From the ascent of Gay-Lussac in a balloon at Paris, September 6, 1804, he derived the proportion of 1° for 346 feet, when the temperature at the surface was 82°, or about the estimated mean temperature of the equator at the ocean-level. It cannot be doubted that a very different configuration of country and a lower temperature would give a different ratio from these, so various are the circumstances which affect the quantity and the diffusion of heat in the atmosphere.

Mr. Blodget uses the more common estimate for Europe and for temperate latitudes, of 3° for 1000 feet. He notices, indeed, the fact, that this is not the true ratio for some localities in our country, and he might have said for many. Below are given a few comparisons, that the reader may carefully consider them.

No.	Latitude.		Elevation.	Temp.	Ratio.
	°	'	Feet.	°	
1. Fort Massachusetts, N. Mex.	37	32	8,365	41.1	1° to 320 ft.
Fort Miller, Cal.	37	00	402	66.0	
2. Fort Massachusetts, N. Mex.	37	32	8,365	41.1	1° to 600 ft.
San Francisco, Cal.	37	32	150	54.9	
3. Fort Monroe, Virginia,	37	00	8	59.9	1° to 445 ft.
Fort Massachusetts, N. Mex.	37	32	8,365	41.1	
4. Fort Miller, Cal.	37	00	402	66.0	1° to 23 ft.
San Francisco, Cal.	37	32	150	54.9	
5. Mexico City,	19	26	7,409	60.4	1° to 486 ft.
Vera Cruz,	19	12	60	75.5	
6. Fort Laramie, Nebraska Ter.	42	12	4,519	50.1	1° to 1660 ft.
Ann Arbor, Mich.	42	15	700	47.8	
7. Watervliet, N. Y.	42	43	50	48.1	1° to 330 ft.
Cherry Valley Academy, N. Y.	42	58	1,335	44.2	
8. Cambridge, Mass.	42	23	0	48.4	1° to 157 ft.
Amherst College, Mass.	42	22	267	46.7	

The two places in No. 1 differ in longitude about 14°, but both are among the mountains. The places in No. 2 differ in longitude about 17°; but San Francisco is near the Pacific coast, and has a much lower mean annual temperature than is due to its latitude as compared with the coast of the Pacific farther north. The places in No. 4 differ in longitude only

2⅔°, but it is the low average of San Francisco that makes the ratio so large. The places in No. 5 differ in longitude 6½°; but Mexico is in a high and warm valley or plain, and hence the ratio is so small. Were we to reduce the temperature of Mexico to that of the ocean, at the rate of 3° to 1000 feet, the reduction would be 22°, and the reduced mean of Mexico would be 82.4°, equal to the mean heat of the equator. This would put it on an isothermal far removed from its present latitude.

This examination shows us that there are such causes at work as make the just estimate of the effect of elevation on temperature very difficult, if not unattainable. Indeed, to determine this, the places compared should have their other climatic relations very nearly the same. But this is the point which cannot be ascertained.

For further illustration, we may consider localities of the same temperature, but of different latitudes and elevations.

	Latitude.		Elevation. Feet.	Mean Temp.
	°	'		°
Fort Vancouver, Washington Ter.	45	40	50	52.7
Philadelphia, Pa.	39	57	60	52.7
Frankford Arsenal, Pa.	40	1	20	52.7
Germantown, Pa.	40	3	70 ?	52.3
Milton, Indiana,	39	47	800	52.2
Marietta, Ohio,	39	25	630	52.6
Fort Leavenworth, Kansas,	39	21	896	52.8
Lapwai, Oregon,	46	27	1000 ?	52.4
Fort Dalles, Columbia,	45	36	350	52.8
Astoria, Oregon,	46	11	50	52.2
Fort Humboldt,	40	46	50	52.1

These temperatures designate the isothermal curve of nearly 52.5°; but the other columns show there is no definite ratio of heat to altitude, which can have any extensive application over our country.

For another illustration, we might refer to the point of perpetual congelation, so far as it is known, on high mountains. This point was found to be at 13,428 feet, by Saussure, on the Alps; on Pinchincha, on the Andes, near the equator, by Bouguer, at 15,577 feet; and on the Himalaya Mountains, at

18,000 feet above the sea, and higher on the north side of the peaks of these Asiatic mountains than on the south side, doubtless on account of the more extended plain northward.

This examination shows also the relatively high temperature of the elevated valleys or plateaus of the Great West.

Santa Fé, at	elevation	of	6,846	feet,	lat.	35°	41′,	has	temp.	of	50°.6
Fort Laramie,	"	"	4,519	"	"	42	12	"	"	"	50.1
Mexico City,	"	"	7,469	"	"	19	26	"	"	"	60.4
Fort Scott, Texas,	"	"	2,060	"	"	30	55	"	"	"	63.2
Fort Atkinson, Plains,		"	2,330	"	"	37	47	"	"	"	54.6
Fort Union, N. M.		"	6,418	"	"	35	54	"	"	"	49.1

The first two of these places have the temperature of Newport, R. I., and of places on the coast of Long Island Sound.

In the discussion on the winds of the United States, Mr. Blodget maintains that winds are the *effect*, and not the cause, of atmospheric changes, such as storms or general climatic results; for wind is itself the effect of change in the temperature, whether the winds be local or general. But this does not prevent their acting as a modifier of climate, when once their current is established by adequate causes. The trade-winds are the result of the sun's heat, and the revolution of the earth on its axis. They are an effect of an adequate cause. But when their perpetual flow to the west is fixed, they are held to have an important action in raising the temperature of the great Mississippi valley. In this important agency they are mentioned by our author. But in this case they operate as a modifying power upon climate. In like manner, the belt of westerly wind north of lat. 35°, of which Mr. Blodget adduces proof, becomes a modifier of the climate by its temperature and connection with rain.

Not to mention the similar action of the monsoons, reference may be made also to the permanent currents of the ocean, as the Gulf Stream. This, though the result of heat, is admitted to affect the climate of the British Isles, and even that of Norway.

There is some confusion of language in respect to winds of *propulsion* and *aspiration*, which the author may remove perhaps by a qualifying phrase, the absence and omission of which results in an obvious contradiction.

Connected with winds are interesting facts as to the fall of rain, which require to be read to be fully estimated. Mr. Blodget assigns the upper westerly current of wind as the chief source of the rain-storms in the temperate latitudes of our country, and alludes to it more than once as an "*exterior source*," because it does not arise from "local contrasts of cool and heated surfaces" of the country and its seas. Hence it is maintained that the rain falls "mainly from the upper or westerly cloud," in the eastern, and, in fact, in much of the western portions of the United States.

Mr. Blodget refers to the statement of Dr. Gibbons, at San Francisco, on the course of the higher visible stratum of clouds, as uniformly from some westerly point, as well as to his own observations to the same effect in the State of New York. Indeed, no accurate observer in New England or New York can fail to be satisfied of the general current of the upper clouds, usually the cirrus, being from a westerly point. In rain-storms, however, there are two currents, and the lower is in some direction oblique to the upper or westerly one, as from the northeast, the southeast, and, in certain common instances, from the south. The common thunder-storm is from the west, or oftener a little north of west, and has its high cap of cirrus-cloud moving directly on from the westerly point, but underlaid with dense and extensive masses of nimbose clouds, or thunder-heads in common language, while the under-current of wind is from the south, carrying the still greater amount of vapor in the lower part of the atmosphere in dense strata at the lower part of the storm-cloud. The mixture of two such currents of air of different temperatures, and saturated with vapor, will evolve rain, and if mixed for some depth will yield a great rain, according to Hutton's Philosophical Theory of Rain. This theory seems to be adopted by Mr. Blodget, as he speaks of the two different currents of clouds preceding the rain-fall. When the two currents mingle by the flow of the lower current from the northeast, or from any easterly quarter, the cause of the rain-fall is equally obvious, and the close of these storms shows to the observer that the upper current proceeds from the westerly point.

It may not be of great importance to ascertain which of the two currents yields the most of the rain in any storm, but it is generally held to be the lower current. The reasons are the following, and they are in entire consistency with the Huttonian theory.

Though the atmosphere is calculated to be at least forty miles in height, one half of it is, from the elasticity of air, within three and a half miles from the surface of the earth; warmer air holds far more water in solution as vapor than the colder, and of course the greater quantity of vapor will be near the earth; the upper tier of clouds, the cirrus, is found sometimes to be at an elevation of three miles; at this altitude is the point of perpetual congelation on the Andes (but lower in the temperate latitudes), the freezing point of water, or 32° Fahrenheit, at which temperature the atmosphere contains only a small quantity of water, not one fourth of the quantity at summer temperature; even if the cirrose clouds are formed at a less altitude, and the stratum saturated with vapor, as it may be at even that of two miles, the quantity of water would be much greater in the stratum below or nearer the earth; and finally, there is no necessity for the supply to come from the upper cloud current. It is improbable, if not impossible, on known principles, that the westerly current of wind and clouds is the principal source of the great rain-falls.

It is fully implied, also, that both currents, so far as they are mingled, are employed in yielding the water precipitated; both currents concur in the production of the rain or snow, even though the lower affords the greater proportion of it. The upper current is essential to the result, by such commingling of the upper and colder stratum with the lower that the clouds may be formed and disappear as falling water.

It is well known from the essay* of Professor Coffin, that there is a prevalent westerly wind at the surface of the earth over a belt of the Northern hemisphere from latitude 35° to near 60°; that is, the high westerly current extends its influence and direction to the winds, at the surface. Across the Atlantic, the westerly is the prevailing wind. But this lower part of the great current is subject to variable winds, coming from every point, from the north-northeast around the horizon to the south, at different times. By these variable winds the water from the Atlantic and from evaporation on the land is wafted in vapor to the westward over a vast area, and the elements are brought together for a rain-storm or a snow-storm, the action of which ceases by the restoration of the westerly current to the surface.

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* Winds of the Northern Hemisphere, by J. H. Coffin, Professor of Math. and Nat. Phil. in Lafayette College, Easton, Penn. In Smithsonian Contributions to Knowledge.

Even in this imperfect view, we see the reason that a storm, or an extensive thunder-shower, can be so readily traced from the Mississippi through Chicago, Cleveland, Buffalo, Utica, Albany, even to the Atlantic, or over a nearly parallel district of country north or south, the velocity varying from twenty or twenty-five to forty, or in some cases sixty miles an hour.

The sudden and great change of temperature, the usual attendant of severe thunder-showers, is doubtless accounted for by the rapid change of vast quantities of vapor into water, evolving an immense amount of caloric, — even a thousand degrees to every pound of water formed and precipitated, — requiring the mixing of two strata of atmosphere of great thickness, and thus in effect bringing down the colder and higher westerly current to the surface of the earth. In his Travels through New England, half a century ago, President Dwight of Yale College, in effect, published this solution of the great change in the temperature above mentioned. However accounted for, the fact will be universally admitted.

Every few years a storm like the following occurs, generally with less severity. In January, 1810, occurred the *cold Friday*, as it was for years called. The weather had been fair and pleasant, and on Thursday the temperature was uncommonly high, rising even to 60°, and the wind from the south. Toward sunset the appearance of a coming storm, like a heavy thunder-shower, was obvious. It burst upon the western part of Massachusetts about sunset, or a little later, in a snow-squall from the north of west, of terrific violence, with the power and fury of a tornado. Desolation marked its course. The cold increased with great rapidity; at midnight the thermometer was at zero, and the next morning at 20° below, in some places colder. Friday was insufferably cold; the wind was strong; the thermometer did not rise to zero over much of New England and New York, and in Canada it was still lower. The storm passed over a large portion of our country, and everywhere with a great degree of cold. It is this fact to which we wish to refer, and to say that it seems inexplicable except upon the descent of the cold atmosphere from above, or its transference from the northern regions.

There is another aspect under which the two contrary currents show their operation in producing a great rain over a limited territory, which is not often noticed or understood, though undoubtedly it often occurs. The following instance will illustrate what we mean. A few years ago there was a great rain in the western towns of Hampden County and the adjoining portion of Berkshire County, Massachusetts. The rain was from an easterly wind, and very moderate on the east of Connecticut River, the lower stratum evidently loaded with vapor from the ocean. In the western towns of Hampden County, from which the waters flow into the Connecticut, a torrent was poured down by which there was great destruction of bridges and the like, not forgotten to this day. On the west side of the mountain ridge in Berkshire County the wind was from the north of west, of a medium velocity of from fifteen to twenty miles an hour, and the clouds thick and heavy. The two currents met upon and east of the ridge of mountains between the two counties, and the resulting condensation was a very great local rain. On the west side of the ridge the rain was moderate, and attracted no special attention even in the middle of the county of Berkshire. In the same manner, no doubt, many local rains, and especially considerable showers, are produced where the action of the two currents is not so clearly to be distinguished, or the attention is not arrested and directed to the subject.

In many cases, also, rain or snow may fall from the condensation of vapor passing into a cooler atmosphere in the vicinity of lakes or large bodies of water. This is often noticed in the vicinity of the southern shores of Lakes Ontario and Erie, especially in the fall of snow in small quantities, or to an inch or two in depth, for only a few—from five to ten—miles from the shore. The same reason doubtless accounts for the great number of cloudy or hazy nights, especially on and along the south shore of Lake Ontario, protecting a belt of a few miles wide from frost in the spring, so that fruit is rarely killed by it, while a few miles farther south, and on higher land, the blossoms of the apple, peach, and other fruit-trees are often destroyed.

Connected with this consideration of currents, another principle is stated in the Climatology, in relation to the cold periods of some of our late winters, namely, "that these cold extremes do not come from the north," and are not "caused by north winds, or an inflection of the polar atmosphere southward." Perhaps it is not proved that the cause of this severe weather is not "exterior to the continent"; but the opinion of some distinguished meteorologists is in favor of the "inflection of the polar atmosphere southward." These severe changes, or "non-periodic depressions of temperature," follow the regular storms, or rather attend them, as in the case of the heavy and extensive thunder-storms already noticed, and whatever is the cause in one case is doubtless so in the other. In summer the cool period is, for obvious reasons, shorter than in the winter, and the temperature less reduced. As the prevalent wind at the time of these changes is westerly, and commonly from the north of west, it might be plausibly maintained that the operation in the elements above the earth either brings down the cold atmosphere in the region of the cirrus clouds, or produces an inflection southward of the colder northern atmosphere. It is not impossible that further observations over the western and northern portions of our continent may lessen the confidence of climatologists in the prevailing opinion or conclusion; but at present it seems more probable that they will sustain it.

The familiar fact, that climate is modified by latitude, is mentioned as leading to the inquiry whether the law of decrease of temperature from the equator has been, or can be, ascertained. Were the obliquity of the sun's rays alone to be considered, an approximation might perhaps be made; but when the difference in the length of the day, or time for which the sun is above the horizon, is to be added, the investigation becomes more complicated. Certainly the law is yet to be ascertained for our country. Relying upon the results of observations, we have begun at New Orleans, in lat. 29° 57′ and long. 90°, where the mean annual temperature is 69.9° Fahr., and compared that with eleven places nearly on the same meridian, the most northerly of which is Fort Winnebago, Wisconsin, in lat. 43° 31′ and about 770 feet above New Orleans. The comparison of these eleven places with New Orleans gives a ratio varying from 1° of temperature for one degree of latitude, to more than 2° for one of latitude. The ratio for New Orleans and Jefferson Barracks, Missouri, there being a difference of latitude of 8° 31′, is 1.8° of temperature to one degree of latitude; for New Orleans and Fort Winnebago, the difference of latitude being 13° 34′, it is 1.9° to one. The mean of the eleven comparisons is 1.9° to one, though they range from 1.6° to 2.5° of temperature for one degree of latitude, neglecting all influence of elevation above the sea.

Again, comparing Savannah with fourteen other places along the coast to Halifax, N. S., we find the ratio for one degree of latitude to vary from less than 1° to 1.9° Fahr. of temperature for one degree of latitude.

For the first 5 degrees of latitude the ratio is	1.5°	to	1°	lat.
" " 10 " " " " "	1.8	"	1	"
" " 12½ " " " " "	1.9	"	1	"
" second 5 " " " " "	2.1	"	1	"
The mean ratio of the whole is	1.7	"	1	"

All these places are but a few feet above the sea. It would appear from these comparisons, that the influence of latitude is not the same for even a few degrees, and that the ratio cannot be considered as a constant; and if reduction for elevation could be applied, the ratio would be increased, but still irregular and uncertain.

The only remaining topic which can be referred to in this article is the "Sanitary Relations" discussed in the work before us. One great object in "establishing a system of meteorological observation by the medical department of the army, was that of sanitary investigation in immediate reference to the health of the troops," and of the inhabitants of different parts of the country. The wisdom and foresight of Mr. Calhoun took a wide and an important range. The last publication from the army observations * contained a very interesting body of facts collected at the various posts. The compiler of the work referred to, Assistant Surgeon R. H. Coolidge, M. D., of the Army, deserves well of his country. In the circulation of his Report among the members of the medical profession, its utility will be proved. But the subject demands an extended review. We cannot even trace at this time the topic as treated in this part of the Climatology. The power of the dry and cold Northern climate in resisting the progress of consumption and permanently curing it, deserves considerate attention. The subject of miasma — but here we must forbear, *when doctors disagree.*

In the examination of this Climatology, we have noticed a few particulars which need not have been introduced, especially in a work so scientific. The reference to magnetism as a possible climatic force, and to electricity as a motive power, will hardly be approved. We have no certain evidence of their action in this case. Even electricity, so common a hobby with theorizers, as the agent in gravitation, light, caloric, and even in chemical affinity, as well as in life, thought, and muscular power, is not *known* to have any connection with them, except in contiguity of time and place. Mr. Blodget notices electricity only as a "*convective*" agent in removing heavy bodies in some devastating tornadoes. So terrific is the tornado, that it may itself be the adequate cause. True, it might be heightened by heavy electric discharges. For lightning has been known to dash down a chimney and scatter the materials, and to split or tear out large portions of living trees which were left standing, and scatter them to a considerable distance, a result of which no mere tornado-force is capable. But such evidences of its power show little connection with any climatic agency.

The faults in the composition of this book are occasional forms of expression not the most perspicuous, a somewhat involved construction of sentences, and in some instances a novel or singular use of words. Of the latter we have *climatological* instead of a shorter and better word, *climatic*, a very natural oversight; as, for instance, a "climatological basin" constituted by the "plains of the Columbia River," that is, a basin which has strong peculiarities of climate compared with the adjacent districts which are noticed.

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* Statistical Report on the Sickness and Mortality in the Army of the United States, compiled from the Records of the Surgeon-General's Office, from January 1839, to January, 1855. Washington. 1856. 4to. pp. 700.

We find, on the other hand, some instances in which a real advantage has been gained by the change of scientific terms, or the use of new terms. Thus we have *thermal*, for the condition of temperature, instead of "thermometric"; *hyetal*, for the rain-condition, in the place of the long and less euphonious "hyetographic" of Berghaus, for the worse "ombrographic" of the French, or in the place of "hyetometric" or "ombrometric"; and *hygral*, for the humid condition, instead of "hygrometric." The obvious analogy of our language is followed in these words.

A generality of statement, which needs some qualification, occasionally appears. It would be easy for a captious reader to offer very severe, yet plausible, criticisms on such assertions.

A due estimate of this work can be formed from the amount of facts, reasonings, and illustrations now presented from it, though but a partial view could be taken in these few pages. For its climatic statistics and illustrations it is invaluable to a great majority of scientific men, to whom they had been inaccessible, and to all general students of physical geography and climatology. That it far surpasses the anticipations of that great body of observers over the country who had begun eagerly to examine this interesting and important subject, may be safely asserted. That the increasing number of observers over the United States and in the regions farther north will, in a few years, enlarge the field of view, and settle some points not yet ascertained, is highly probable.

In conclusion, we would point out some desirable improvements in the observations to be made.

1. We would suggest the adoption of one uniform set of hours for thermal observations, as 7 A. M. and 2 and 9 P. M., as required by the observers for the Smithsonian Institution and at the military posts of the United States. Even the amateur observers will in this way greatly increase the

value of their results. In numerous cases, entire confidence cannot be placed, because the hours selected have not been the same. For a few years other hours of taking the observations were used at the military posts; but four hours happened then to be adopted which are found to give very nearly the same results as are derived from the three mentioned, — only the labor was made one fourth greater with no advantage. But it is to be feared that the results of too many of the early observations in Europe and America are only a very remote approximation to the truth.

2. In all cases observers should adhere to the hours selected, as the difference of half an hour often makes several degrees of difference in the temperature. There are no adequate data on which to make satisfactory reductions. The labor too is great for obtaining only an approximation to an approximation. The observations for the ten years from 1855 ought to exceed in value all those previously made in North America. Attention to these two points will secure this great object. Their importance cannot be over-estimated.

3. Particular attention should be given to the course of winds, especially to the course as shown by the upper clouds. The winds at the surface are often local; the upper must be more general. In valleys between ranges of mountains, only the winds indicated by the clouds can have any general importance. The different currents, when there are two tiers of clouds, should be recorded. The tracing of storms in their progress over the country, and the times of commencement in different latitudes or longitudes, or both, must lead to important conclusions. In determining the course of winds by the clouds, let those *passing over the zenith be noticed as unerring guides*. It is obvious that clouds in the southern horizon, for example, may appear to move from the west, when they are actually moved by winds from the northwest or southwest.

4. Constant and careful attention should be paid to the thermometer, as heat is the all-important element in climate.

Vast has been the labor expended in the observations already made; the great results have begun to appear. The effort must be continued, and it will effect immeasurably greater results. As was said of the moving power in another case, so will it yet be said in this great interest of science and humanity, — "Labor omnia vicit improbus."

Art. III. — 1. *A Chronological History of New England, in the Form of Annals, etc.* By Thomas Prince, M. A. Boston, N. E. Printed by Kneeland and Green for S. Gerrish. 1736.

2. *Catalogue of the Library of Rev. Thomas Prince, presented to the Old South Church and Society.* Boston. 1847.

3. *Proposals of the Prince Publication Society.* Boston. 1859.

One of the most disinterested pleasures enjoyed by the student of history is the almost personal acquaintance he forms with those celebrities of a former day who are to the multitude but shadowy names. A more selfish but a more beneficial result of his study is seen when he is enabled to gain the attention of a public desirous only of entertainment, and, by interesting it, to impress upon its memory the distinct idea which has been depicted gradually upon his mind. If his own image be clear and well-proportioned, whether it be true or false, he will communicate an impression as fresh and interesting as the critic's analysis of the last new author. The public will be zealous to atone for the neglect which has so long attended the subject, will eagerly adopt the judgment of the writer, and permit it to stand as the award of History, until some other ardent advocate arises to repeat the process, and to intensify or contradict the prevalent opinion.

This revival of a defunct reputation is constantly occurring, and it may be one of the necessary results attendant on the easy publication of so many works. We can hardly point to an English author of note whose reputation has not thus waned and been rekindled. In this country, the space covered by our record is so limited, that but few instances can as